REVIEWS.

ART. XX.—*Die Tuberculose, die Lungenschwindsucht und Scrofulose. Nach historischen und experimentellen studien bearbeitet.* Von Dr. L. WALDENBURG, Privat docent an der Kœingl. Universitæt zu Berlin. Berlin, 1869, pp. 560.

Tuberculosis, Pulmonary Consumption, and Scrofula; historically and experimentally studied. By. Dr. L. WALDENBURG, private teacher at the Royal University of Berlin.

> "The progress of science resembles the course of a spiral. It advances continually by departing from the centre and returns in circle-movement ever again towards it. The short-sighted either observe only the advance and overlook the return, or, on the contrary, recognize only the circular motion and the advance escapes them. Science, however, presses eternally forwards, but is ever bound, in the mean time, by the limiting radius of human knowledge."

DURING a period of progress more marked than any probably in the history of medicine, and at a time when the fundamental branches which underlie the therapeutic art are especially the subject of close reinvestigation, it was not to be expected that tubercle could escape attention. The diseases resulting from it, or attended by it, are too widespread in their prevalence, too frequent in their occurrence, and too fatal in their course to allow of the subject occupying a secondary position among those claiming the attention of the profession. There is, besides, the deep mystery which yet surrounds the origin of this pathological product, to add to the interest attending its study, because this origin is reasonably connected with the power to cure, or more certainly, with the power to prevent. It is a mystery yet hidden among the minute ramifications of artery, vein, and bronchiole, the changes of plasma and cells which attend the primary processes of nutrition, and not until we have solved it may we expect to control those diseases which now too often baffle our most persevering efforts.

The immediate cause of a renewed and eager study of the subject of tubercle within a few years past was the discovery of a remarkable fact in regard to it. We allude, of course, to the discovery of its inoculability by Villemin. He read his memoir before the Academy of Medicine, of Paris, in December, 1865, and the conclusions to which he arrived were such as to awaken the most profound attention. That tuberculosis is a specific affection—that it has its origin in an inoculable virus—that it belongs to the zymotic diseases and is allied to scarlatina, smallpox, and syphilis, and more nearly still to glanders—these are propositions which, if true, revolutionize all received doctrines, and compel the profession to study it anew. No wonder that Villemin's statements were received with "general distrust;" no wonder that the study was immediately commenced, his experiments repeated in every quarter and the results watched with the most eager interest.

To the impetus thus given to the study of the pathology of tubercle we owe the book whose title and motto are placed at the head of this article. The author's name has been heretofore, so far as we can learn, and certainly on this side the Atlantic, unknown to fame. It appears that he is editor of the Berlin *Klinische Wochenschrift*, and from a casual reference we find that he has previously published one work upon the subject of respiratory therapeutics,[1] which we now regret we have never seen.

However unknown the author's name may have been heretofore, we are much mistaken if it be not familiar in the future. In the composition of this work he has certainly shown most excellent scholarship and the greatest industry; it exhibits alike the close study and conscientious judgment of the historian, the patient exactness of the experimental physiologist and the careful reasoning of the philosophic physician. We are aware that this is saying a great deal, yet it is justly deserved; nor are we alone in our opinion as to the merits of the book, for very high authority has termed it "one of the most valuable and important medical works which has appeared for many years." In the historical portion the author presents the views of every writer upon the subject, from the time of Hippocrates down to the date of publication; he has gone to the original sources for his information and gives exact references to every author quoted. The mass of material at hand for this portion of the work must have been immense and the labour commensurate. The experimental portion exhibits the most scrupulous effort to exclude every source of error and to attain the truth regardless of any effect it might have upon past or present doctrine. Finally he states the conclusions to which his study of the subject has led him; that they are the honest convictions of an earnest student is apparent; that they are complete he does not claim; that they can be final in this transitive period of knowledge in which we live is scarcely possible. Nevertheless, he advances so many arguments in support of them, from experimental physiology, from pathology, from clinical observation, and from reason as to compel our attention. Possibly the near future may dispose of his theories as the past has disposed of so many others, and by enlarging the field of our vision reveal to us what he does not see, yet we cannot now afford to neglect his labours. The facts he presents will always be good, and the theories cannot but serve to help us forwards. If it shall be proved that all his doctrines are fallacious, and leaving his experimental researches out of view, still the skill with which he has traced a most complicated web of doctrine, the assistance he has rendered towards the attainment of a consistent nomenclature, and the clearness with which he has separated the known from the unknown would make his work a most valuable contribution to our science and demand from us a careful examination.

As before said, the verification or refutation of Villemin's doctrines was the author's starting point, and he confesses that he entered upon his task sharing the general distrust. This scepticism as to the inoculability of tubercle was speedily removed, however, by experiment, but he found himself forced to a very different interpretation and application of the facts. This led him to a study of authorities upon the subject, and he was immediately struck with the wide disagreement existing among them; views opposite, and even directly antagonistic, were held by writers, while from a different application of the same terms there had arisen the most bewildering confusion :—

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[1] Die Inhalationen der gerstäubten Flüssigkeiten sowie die Dämpfe und Gase in ihrer Wirkung auf die Krankheiten der Athmungsorgane. Preischift. Berlin, 1864.

> "There reigned here a confusion such as is seen in few other branches of medicine. Besides the confounding of tuberculosis with pulmonary consumption, one author denotes by 'tubercle' a very different thing from another; what one calls tubercle is to the other nothing but the product of cheesy metamorphosis; what by this one again is called tubercle is by the other termed 'granulation;' a third calls both tubercle; finally for one of the parties the original term tuberculosis disappears entirely to be replaced by granular metamorphosis. A final union of the parties is now a pressing necessity if science is not to suffer serious injury from what is for the most part a verbal conflict."

A glance at the accepted text-books in our language will show how true this is, and show too that the confusion has been made more bewildering by the attempt of those holding different views to designate one among the different substances known as tubercle as the "true," or "real" tubercle; evidence enough that there has arisen a pressing necessity for a distinction being made. Nor do we find any greater harmony as to the nature of scrofula and its relations to tubercular disease. It is at once the cause of tubercle and the effect of the tubercular constitution; by some it is held to be something entirely different from tubercular disease, closely related to it by others, and by many they are looked upon as identical, and the terms are used synonymously.

To trace out the origin and growth of this confusion the author entered upon the historical study of the subject, believing this, too, to be the best means of removing so great a hindrance to further progress of the subject. How thorough and complete that study has been, we have already stated. But through this portion of the work it is of course impossible for us to follow him, although there is no lack of matter either interesting or instructive.[1] Still, enough must be gleaned from the historical portion to furnish us a clue for guidance through the labyrinth of conflicting doctrine, nor do we think we shall be performing needless labour for many of the profession in this country, if we present the views of the late German school upon this most important subject. Fortunately we do not have to go very far back into the past; "in ancient times and in the middle ages miliary tubercle was entirely unknown," that important kind of tubercle—that which to most of the German writers and to our author *is alone tubercle*, is a discovery of very recent times. In the whole history of this subject it is astonishing how few doctrines need to be examined except those of teachers from whom the present generation of medical men learned pathology, and this gives to this portion of the subject the strong attraction of warm personal interest.

It was only with the rise of anatomy in the sixteenth and seventeenth centuries that progress in knowledge of tubercle became possible, and then it was made but slowly, and, as in other branches of learning, with long intervals of cessation and frequent periods of retrogression. Only slowly was the Hippocratic doctrine of ulceration and suppuration of the lungs abandoned; and an anatomical connection shown between vomicæ, and those pulmonary deposits which were generally termed "tubercles" in the sense of "nodule," without reference to any special composition or structure, and sometimes "scirrhus" from their hardness; and only slowly was the fact established, that these are not diseased glands, imperceptible in health, but a pathological product *sui generis.*

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[1] One fact too interesting to be omitted, is, that Addison taught a direct origin of the pus corpuscle from the colourless blood corpuscles, so lately experimentally established by Cohnheim. The reference is to Trans. of the Provincial Med. and Surgical Association, vol. xi. p. 247.

Modern progress may be said to have begun with Stark and Reid; the former had been dead fifteen years, when the results of his labours were published by the latter in his work entitled "An Essay on the Nature and Cure of the Phthisis Pulmonalis," [London, 1785]. The service of Stark was the description and establishment in pathological anatomy of miliary tubercles, until then only incidentally mentioned and considered as of but seldom occurrence. They had been discovered by Manget, and a description published in 1700, but his labours had been entirely overlooked for nearly a century. To Reid is awarded the credit of having entirely separated scrofula from tubercle, and of settling the question as to tubercles being diseased glands.

Baillie was the next to make essential progress in our knowledge of tubercle. He taught the formation of the larger pulmonary nodules from a confluence of miliary tubercles. He did more—

> "He separated already—and this is also an important advance beyond his predecessors—the nodules formed by a conglomeration of miliary tubercles from other deposits, which were later described as infiltrated tubercles, but which, until now, had been included in the term tubercle."

The substance of these deposits—the later so-called cheesy matter—Baillie declared to be "scrofulous matter," and considered it identical with the material of tubercle.

> "With this acceptance of the idea of scrofulous matter, a new and essential point was gained for pathological anatomy—*the distinction of tumours and deposits according to the constitution of their substance.*"

Baillie rendered another important service in describing the tuberculosis of other organs besides the lungs, as the liver, spleen, kidneys, and cerebral meninges.

Portal, who published his work during the French Revolution, did not add much to Baillie's facts, but made a great and important change in his *names* :—

> "The steatomatous matter (our caseous), which Baillie calls scrofulous, received from Portal the name 'tuberculous.' With this designation, which, unfortunately, rapidly established itself, was laid the foundation for all the future confusion which reigned in the doctrine of tubercle, and which prevails in our day."

While "tubercle" originally meant a nodule, or a projection simply, without reference to composition, the term had gradually been limited to those nodules in the lungs having a certain resemblance to glands, and was afterwards applied to those nodules in other organs resembling the pulmonary. These nodules or tubercles were sometimes firm and hard, sometimes soft, steatomatous, and cheesy.

> "While now there was all at once *one* condition of the development of these tubercles chosen out, that namely of a steatomatous or cheesy consistence, and designated as tuberculous, there was committed a *logical fault,* which was doomed to severe punishment. Logically this step should either not have been taken, or if taken then the term tubercle for the nodules should have been given up, and another name substituted for it. For thus was brought about the unfortunate condition that there were, on the one hand, tuberculous affections

> that had not the slightest connection with tubercles, and, on the other hand, tubercles in a certain stage of their development, that is so long as they were firm and hard, that, strictly speaking, were not tuberculous. It would certainly have been better to have retained Baillie's designation of 'scrofulous matter,' although by it a connection with scrofula was assumed which had not been proved."

Bayle, the immediate predecessor of Laennec, whose "epoch-making" work appeared in 1810, is the next great labourer in the field. He first applied the name "miliary" to tubercles, first discovered them in the larynx and trachea, and, far more important, first pointed out that clinical and genetic connection between the affection of these different organs which all before him, even Baillie, had failed to see. Consumption was no longer a local disease confined to the lungs, but a general disease affecting the whole body—a chronic disease of special nature, and not depending upon inflammation of glands or lymphatics.

> "In the clear demonstration of these facts lies Bayle's most important service, which will make his name immortal in the annals of science."

Bayle created then the tuberculous diathesis. He committed, according to our author, the error of Baillie and Portal: the softening and caseous change of the deposited matter he looked upon as pathognomonic of the tuberculous degeneration, whether the matter was in the form of nodules or infiltrated—the kind of matter was of more importance than the form; "tubercle loses its meaning of a nodule entirely, and in its place appears the 'tuberculous matter.'"

> "What was gained thereby? In the place of scrofulous matter, was tuberculous, instead of scrofulous degeneration, we have tuberculous, with the open acknowledgment that the idea remains the same and only the names are changed."

Besides miliary tubercles, Bayle also describes miliary granulations which are distinguished from the tubercles by being transparent, shining, of the consistence of cartilage and do not soften, and which Laennec looked upon as the first stage of miliary tubercles, although their discoverer did not.

Bayle's doctrines in regard to consumption were also important; he recognized six different forms, all depending upon different diatheses: "He denied finally, that phthisis ever originated in inflammation of the lungs, of the pleura, or of the bronchiæ."

> "Through all these, mostly radically new views, the doctrine of phthisis underwent a reform which must be considered as an almost complete overthrow of doctrines which had reigned for centuries, and as an entire change of heretofore reigning ideas."

Bayle's doctrines were continued with some modification by Laennec [1781-1826], and his authority was so great as to make what he taught the generally accepted doctrine down to within a very few years past. Indeed it is probable that Laennec's views still rule the greater portion of the medical world. His discovery of auscultation, his promotion of percussion, above all "the wonderful power he exhibited in so modifying and rebuilding the pathology of the thoracic organs as to establish a complete harmony between it and the new mode of physical diagnosis," were sufficient reasons for this wide-spread and lasting influence. He taught that the granulations of Bayle were only a primary form of miliary tubercle; his description of the change of the miliary into "crude yellow tubercle" is termed by the author classic; but according to him this crude yellow tubercle always originates in the same way, whether found as nodules —"isolated tubercle"—or in irregular masses—"tuberculous infiltration;" the term "tuberculous matter" was therefore applied to all forms, and covered all the stages of change of matters deposited in the lungs.

> "It is remarkable that Laennec did not recognize the danger to science of the adoption of the term 'tuberculous matter.' While he represented by 'tuberculous' so complicated an idea, which did not accurately express *one* quality or condition, but extended to, and included a succession of various stages of development, every application of the word to a case logically expressed a series of suppositions and consequences which, for the special case, was very often not—and, strictly speaking, never—susceptible of proof. If, for instance, a cheesy deposit in any organ was termed tuberculous, the hypothesis was thereby involved that this cheesy matter had been first gray, and more or less transparent and hard, that it then formed a crude yellow tubercle, and that it finally softened and passed into a centre of ulceration."

> "How much Laennec was under the influence of this conviction, or rather of this prejudice, we can best see by the fact that when he observed these cheesy deposits in cancerous tumours, he did not hesitate to designate them as tuberculous."

Passing now to consumption: Bayle had made six species of the disease; Laennec rejected all but the "granular" and the "tubercular," but as the granulations were, in his view, only an early stage of tubercle, there remained only one form of this disease. "PHTHISIS ALWAYS DEPENDS UPON TUBERCLE." This became a dogma, and has maintained its sway over the medical mind down to the present time. As a consequence, "PHTHISIS AND TUBERCULOSIS BECAME IDENTICAL."

So in regard to scrofula:—

> "Laennec breaks entirely with the old doctrines concerning the relation of tubercle to scrofula. Scrofula, which until now had played so important a rôle in science, and which had particularly predominated over tubercle from its discovery, was sunk suddenly by Laennec to an entirely subordinate position. While until now the term scrofula had corresponded to the far more general idea, and tubercle appeared only as a species of it, the tuberculous diathesis was now raised to the more extended idea, and the scrofulous affections of glands became only a variety of it." . . . "The general idea of scrofula has dwindled, and, since an exact basis is withdrawn from it, threatens to wholly disappear. The place of scrofulosis is occupied by tuberculosis."

Wide-spread and lasting as Laennec's influence has been, his views found opponents even among his contemporaries. Broussais especially combated them; his doctrine of "irritation," as the great principle of pathology, led him to far different conclusions, and inflammation became again a cause of phthisis. "Tubercle, or rather tuberculous matter, is nothing but a product of inflammation." With both Laennec and Broussais phthisis depended upon tubercle, but with the former it was a neoplasm, with the latter an inflammatory exudation. We have seen over what wide changes Laennec extended the term tuberculous; Broussais applied it only to the cheesy matter; the isolated or nodular form lost its particularity. Out of this came confusion.

> "Contemporaries and successors adopted the apparent agreement in the doctrines of the two great masters; they identified phthisis with tuberculosis, and accepted the tuberculous matter as the essential point of tubercle. . . . . What is to be regretted in the contest of these two great men is not their opposition upon most important points, but, on the contrary, their agreement in uniting isolated tubercle with infiltrated by the use of the term 'tuberculous,'

and thereby establishing both as synonymous. In Laennec's and Broussais' doctrines was planted already the germ of the future division of miliary and isolated tubercles as neoplasms from the so-called tuberculous infiltration as a product of inflammation."

But the doctrines of Laennec found a far more formidable opponent in the great clinical teacher Andral, whose arguments were sounder than the hypotheses of Broussais. His great fault is stated to have been generalization from too limited a number of cases. His starting point was crude tuberculous matter, and not miliary tubercle. This matter he believed to have been originally fluid, and to have undergone a process of thickening; tubercle is therefore no longer a neoplasm, but a secretion product, and he inclines to the belief that it existed in the blood before being deposited. Pus, he says, he has more than once seen undergoing the process of inspissation, and changing into that form of matter universally termed "tuberculous."

> "Andral knew then very well the process of cheesy degeneration, or, as it was at that time termed, 'the tuberculization of pus;' he describes, in the most precise manner, that form of inflammation which leads to caseous or 'tuberculous' products—those tuberculous deposits which, far from originating in gray, hard miliary tubercles, are nothing but thickened pus. By the establishment of these, in later times, ever more and more apparent facts, he earned the title of forerunner of Reinhardt and Virchow, and gave to Laennec's doctrines a most powerful blow."

He carried the application of his facts too far, however, in maintaining that all tubercle originated in this way. Laennec's "classic" description of the change from miliary tubercle into yellow he entirely ignored.

Another important doctrine of Andral's was, that the granulations of Bayle were circumscribed inflammation of the pulmonary vesicles, or "partial vesicular inflammations within the parenchyma of the lungs," a doctrine which, of course, removed them from all relationship with the tubercles of the pia mater.

> "We see in Andral, consequently, that confusion which had been brought about by the introduction of the illogical term 'tuberculous,' already in full bloom. On the one hand, simple pus, when thickened to the consistence of cheese, is called 'tubercle;' on the other hand, the peculiar gray miliary tubercle is not tuberculous."

Into the particulars of his doctrines in regard to phthisis we cannot go, but give the summing up :—

> "In accordance with this theory, and also sustained by practical experience, Andral held—with Broussais and against Laennec—*that inflammation, whether of the bronchial mucous membrane, of the lung tissue, or of the pleura, as well as hæmoptosis, may be considered as the most common cause of pulmonary consumption.*"

In support of Laennec's doctrines now appears Louis, who defines tubercle as the opaque cheesy matter—with whom "the original idea of tubercle as a nodule is entirely lost"—who denies, *in toto*, the origin of this substance in inflammation. His great influence established Laennec's doctrines upon a firm basis in France, but by no means ended the discord so far as other countries were concerned.

We do not deem it necessary, and it certainly is not possible here, to follow the various changes of the doctrines which now followed in Germany and England, however interesting it might be. Having shown, very briefly, how the confusion arose, and shown that there has been, in the past, very high authority, practical as well as theoretical, for an inflammatory origin of consumption, we must pass over much that deserves our attention. In Germany the labours and doctrines of Meckel, Schönlein, Rokitansky, and Vogel, with the chemical researches of Simon and Lehmann, in England the writings of Alison, Addison, Carswell, and Clark, all contributed to the advance of the subject, although but few of them agreed either upon the minute pathology of tubercle or as to the origin of phthisis. Their differences and their agreements we cannot stop to point out, nor to indicate what each contributed which was new and valuable, but must hasten on to that latest period of the subject in which we live and take part.

The latest period in the doctrine of tubercle may be said to have opened with the microscopical study of the subject, and have reached its full development under the great teacher of cellular pathology. From 1841 to 1844 the investigations of Gluge and Lebert were published, and the appearance of the latter's prize essay in 1849—" *Traité pratique des Maladies scrofuleuses et tuberculeuses*"—placed the subject under the dominion of the microscope. The tubercle corpuscle became the characteristic sign of tubercle as the cancer cell was of malignant growths. Differing from every other physiological and pathological product, the red and colourless blood-cells, the pus corpuscles, etc., a certain and reliable means of deciding what was tubercle seemed at last to have been discovered. As these corpuscles are to be found in the affected glands of scrofula, the influence upon the doctrine was direct. But, we are told, Lebert was too good a *clinicien* and had had too much experience to be able to abandon the idea of scrofulous diseases as different from tuberculous; he therefore "held fast to the clinical idea of scrofula while he took from it all anatomical support." There is no scrofulous matter, but scrofula affects more the external parts of the body, and tubercle the internal organs. At that time, too, Lebert denied the inflammatory origin of tuberculous matter ; now, we are informed in a note, he is inclined to consider not only tubercular infiltration, but tubercle as products of inflammation.

Scarcely were these doctrines spread abroad before they found not only opponents, but, according to our author, refutation, for Reinhardt in 1847 "proved" that the tubercle corpuscles may be formed from pus cells, and in an elaborate essay sought to prove that tubercle is in reality nothing but a product of inflammation. Further with his doctrines it is not necessary to go, for they were speedily overshadowed by those of Virchow; his wonderful powers were directed to the study of this important portion of pathology, and to the conclusions arrived at and doctrines taught by him we must give considerable share of our attention.

> " In this condition Virchow found the doctrine of tuberculosis, as he began in this special subject as in all others of medicine, his epoch-making labours. It may be said that there existed at that time a contest of all against all ; no principle was so universally recognized as not to be combated by facts ; the confusion had reached its culminating point. Upon one side stood Laennec's theory, stoutly maintained with all its consequences by Louis ; diametrically opposed to this were the doctrines of Broussais, Andral, and Reinhardt ; Rokitansky's views resembled Laennec's, but with considerable modification of some important points ; Lebert again presented Laennec's theory with other modifications ; Engel agreed in some respects, but not entirely, with Andral and Reinhardt ; Vogel stood midway between the contending parties.
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> " To bring order out of this general confusion Virchow was destined. It was clear that neither of the contending parties rested its claims upon mere

> hypothesis; each of them was able to advance *facts*. But each party either ignored the facts of the other or nullified them by excessive scepticism, while from its own facts, the results obtained from a certain series of cases, it generalized beyond all bounds, and often followed them to the most extreme consequences."

Almost simultaneously with Reinhardt, in 1847, Virchow had proved that the cheesy matter, then universally designated as tuberculous, was not necessarily of a specific character, but was in many cases nothing more than *thickened pus ;* that it may often be found even in the middle of malignant tumours, a fact already known, but wrongly interpreted—the microscope proved it to be in such cases a collection of *degenerated cancerous tissue.* He agreed, too, with Reinhardt in teaching that this "tuberculous" matter in the lungs of consumptives was very often the result of the inflammatory process—that it was undoubtedly inspissated pus.

> "But happily Virchow did not arrive at the blind and too sweeping conclusion that therefore all tuberculosis was the result of inflammation, and to strike tubercle out of pathology as an independent formation. Rather recognizing on the one hand that the tuberculous matter might be an inflammatory product, he did not on the other hand surrender the old theory of Laennec, sustained as it is by exact observations, that primary gray miliary tubercles, to be considered as organized new formations, might also undergo the cheesy degeneration. The transformation into a tuberculous substance, as Virchow himself at that time termed it, or the 'tuberculization,' is consequently no specific process belonging to a certain dyscrasia, but a process which the most different pathological products, as pus, tubercle, cancer, etc., may undergo; it is *one of the various forms of retrograde tissue-destroying metamorphoses.*"

In 1852 Virchow proposed a new nomenclature of the subject embodying the views just presented. Holding fast to the idea of tubercle as a nodule, not a nodule of any structure whatever, but one having all the special characteristics which had been described as belonging to miliary tubercles since the time of Bayle, he restricted the term to these bodies alone :—

> "In short the term tubercle *must be restricted to the neoplastic miliary tubercles or granulations.* On the contrary, that which since the time of Bayle, Portal, Laennec, has been designated as 'tuberculous,' must—because according to the latest researches, it is only a condition of matter in a certain stage of pathological change, because it does not, as held by Laennec, originate entirely and alone in gray miliary tubercle or gray infiltration, but may be derived from the most various pathological products, and therefore is proved not to be specific—necessarily receive another name, and none can be better adapted to it than that already frequently applied, that which designates its characteristic consistence, and appearance 'cheesy.' 'Tuberculous matter' therefore becomes 'cheesy' or 'caseous,' and 'tuberculization' 'cheesy metamorphosis.'"[1]
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> "With the separation of the two ideas of tubercle and cheesy deposit were the bonds finally broken which, since the time of Bayle, had restrained the free development of the doctrine of tubercle. Tubercle—*i. e.*, the gray neoplasm which generally appears in miliary deposits—in its farther progress *may* undergo cheesy degeneration; indeed, this is the customary termination, but this process has no *necessary* connection with tubercle, for the tubercle may pass through other kinds of metamorphosis, it may undergo the calcareous degeneration and obsolesce, or the fatty and ulcerate. Just as little as tubercle is exclusively

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[1] On a previous page of the history we learn that Craigie, in his *Elements of General and Pathological Anatomy*, Edin., 1848, proposed the Greek term "tyrosis" for this degeneration, and "tyroma" for the substance.

bound to caseous degeneration is the caseous degeneration bound to tubercle; the most various pathological formations, among other metamorphoses may undergo the cheesy."

The author regrets that these views of Virchow, in regard to tubercle and tuberculosis, have found so little favour even among his own countrymen. Of late, he says, they are rapidly gaining adherents, and Niemeyer especially applied them clinically. Niemeyer occupies a high position as a writer and practitioner, and ranks among the best clinical teachers of Germany. He divides pulmonary consumption into two groups, one depending upon miliary tubercle, the other the result of chronic pneumonia. He goes farther than Virchow, however; it is not only a certain kind of pneumonia which may cause phthisis, but every simple inflammation of the lungs may result in it. While it is chronic catarrhal pneumonia which most frequently leads to caseous deposit and consequent ulceration of the lungs, and this is the most frequent form of consumption, the acute catarrhal and the croupous forms, also, frequently end in phthisis. The phthisis resulting from miliary tuberculosis is, therefore, according to Niemeyer, the only form *not* dependent upon inflammation for its origin. He also restores to honour the doctrine of the ancients, that *phthisis may arise from hæmoptysis.*

> "The real miliary tubercle causes phthisis only in the rarest cases; it is rather, in general, a disease resulting from ulcerative pneumonia—a complication of an already existing phthisis. *The greatest danger to a consumptive is that he may become tuberculous.* Many of the best-marked cases of phthisis run their fatal course without tuberculosis, so that at the *post-mortem*, in spite of great destruction of the lungs, not a trace of miliary tubercle is to be found."

The sketch we have given and the extracts made from these two writers, will serve to show the direction of the current of the doctrine of tubercle in Germany—there is a decided tendency to settle down to something near the doctrines of Virchow and Niemeyer. It is different in France; there a confusion reigns greater than any which has yet prevailed. To try to trace out the conflicting theories of the various authors would be here a waste of time. We can only say that the latest important work on the subject is that of Empis, published in 1865. He holds views which are in some respects different from any other authority, and his nomenclature only complicates and confounds, if possible, worse than before. Two articles of his creed, however, deserve mention: one is a belief in recovery from miliary tubercle—a belief based upon post-mortem examinations, and the history of cases which are presented in his work; the other is that *miliary* tubercles are a product of inflammation.

The condition of the subject in France, then, is briefly given as follows:—

> "Among the latest writers upon tuberculosis, Cornil and Herard occupy nearly Virchow's ground. The majority of French physicians, however, yet follow Laennec and Louis, and especially Lebert. The old doctrine of Laennec has been, in the latest times particularly, brought into vogue by Villemin. Added to these are the adherents of Andral and Cruveilhier, and in this variegated company stands Empis with his new theories, almost isolated."

The author having finished the history of the subject, enters, in the second section, upon "The present condition of the doctrine of tubercle, phthisis, and scrofula." It opens with a discussion of the nomenclature—a running commentary upon the different applications of terms by various authors. Enough of this has been presented, we think, to convince every one of the necessity there is for reform in this respect. Uniformity in the use of terms is an indispensable requisite for further, progress. Laying down the undeniable propositions that scientific terms should be used with such precision that they can be applied to but one thing—that a name should not carry with it the idea of a process—that its use should not imply any theory of origin or development, he justifies the preference he has shown for the nomenclature of Virchow, by the facts that the term "tubercle" agrees with the original meaning of the term as a "nodule;" that the word "cheesy" should be used because it strikingly expresses the characteristic appearance and consistence of the matter, and is not new, but has long been used by writers on the subject; that, therefore, this nomenclature is in entire harmony with the pathological truth, and with the historical development of the subject. Its adoption would bring order out of confusion, and neither promote, interfere with, nor conflict with any theories. Besides, it has already gained considerable ground in the scientific world, while the latest nomenclature of Empis, of "granulations" and "granules," only further complicates the subject, and has not been adopted to any considerable extent even in that writer's own country.

The subject of this section—the present pathology of tubercle, as derived from the best authorities of the present day—deserves brief statement. First of the "granulations," we have this paragraph of interest:—

> "The term 'granulations' must be retained in science for a certain form of miliary neoplasms, which, it appears, are essentially different in character and development from the real gray miliary tubercles. It belongs to those fibrous or cartilaginous bodies particularly described by Andral, which are found on serous membranes, but also in the lungs, and which neither undergo cheesy degeneration nor, in general, softening. These bodies are colourless or clear gray, more or less transparent, and tolerably shining, often with black stripes running through them; of the size of lentils or millet seeds; generally rounded; mostly as hard as cartilage, in rare cases, however, softer; and are formed from fibrous tissue. Those found in the lungs are, according to Andral, with whom Virchow agrees, often only hardened lung vesicles. 'Others are,' according to Virchow, 'indurated conditions connected with bronchitic and peribronchitic processes.' The granulations have not, like tubercles and the cheesy hepatizations, a predilection for the upper lobes, but affect all parts of the lungs in like proportion. Whether we consider the granulations, not only of the lungs but of the serous membranes, with Andral, a result of the inflammatory process, or as simple fibrous neoplasms, and whatever their mode of origin, they differ from real miliary tubercle in their external appearance, and especially in their development; they remain as indurated points, or obsolesce and calcify, but do not become cheesy like tubercle. Whether these granulations depend upon a general diathesis, whether there may not be some genetic connection between them and miliary tubercles, upon what causes their existence depends, under what circumstances they arise, and what influence they exercise upon the general organism—these are questions which have not yet approached solution. The whole subject lies yet in entire obscurity."

It is not necessary to describe minutely the miliary tubercles, since their characteristic appearance is given by every author, and, whether strewn through the organs or conglomerated together as "isolated tubercles," they are well known. Microscopically, they are seen to consist of cells, with membrane, nuclei, and nucleoli; cells which "bear the greatest resemblance to the colourless blood-cells or the lymph corpuscles." They are very variable as to size and shape, their figure undergoing change from external force, or possibly from an internal power of contractility, which is not, however, yet proved.

As to the point of deposit of tubercles in the lung, there is, as is well known, wide variation of opinion among authorities. We, therefore, give what is said upon this point:—

> "The seat of miliary tubercles in the lungs is, so far as it can with any certainty be made out, the alveolar walls, formed of fibrous and elastic fibres, or the interstitial fibrous tissue found between the pulmonary lobules and lobes. The smaller and finest bronchia are the chief points of origin—not, indeed, the epithelial membrane, but the layer of fibrous tissue immediately under the epithelium and the peri-bronchitic fibrous stroma—finally the walls of the vessels."
>
> "It is proved, thus far, that miliary tubercles, wherever they are found, have their origin in the fibrous tissue, or in tissues allied to it, osseous and lymphatic."

The order in which the different organs are affected by miliary tubercle does not differ much from the well-known scale of Rokitansky Their appearance along the line of the bloodvessels has been especially remarked by many independent observers, and is a striking fact connected with them: the external coat (adventitia) of the smaller vessels seems to be a favourite point of deposit for them, and this may account for their frequent occurrence in the choroid membrane, while in non-vascular tissues, like cartilage, they are never found.

> "Among the membranes affected by miliary tubercle the choroid coat of the eye has been shown, in the latest times, by Cohnheim, to be of especial importance; not only has their existence, in general, and especially in acute tuberculosis, been proved *post mortem*, but even during life their presence can be discovered by the ophthalmoscope [von Graefe, Franke, Lebert], and thus an important aid to diagnosis during life is afforded."

The progress of the deposit of miliary tubercle is either acute or chronic. The former attacking simultaneously many organs, and running a rapid course, with symptoms much resembling typhoid fever. The latter spreading from the organ first affected, which is most frequently the lungs, and one deposit following another in succession and with more or less rapidity. In the acute cases the author deems it of the very first importance to look for evidences of a primary deposit from which the general infection may have proceeded. In the great majority of cases, when looked for, it has been found, and by such observers as Buhl, Rokitansky, and Virchow. Such primary points of departure of a tubercular eruption—infection-deposits, the author calls them—need not, necessarily, be themselves tubercular, but may be of the pneumonic cheesy nature. This is an important point, one upon which he lays great stress, and of which we shall hear more.

It remains to state the further stages of development of miliary tubercle:—

Among the *certain* terminations is Rokitansky's "obsolescence;" the tubercles shrink and dry, and remain as firm particles imbedded in the tissues, sometimes ossifying. Rokitansky held this to be the only termination of miliary tubercle; according to the author, it is the most seldom.

According to Empis, miliary tubercles not rarely become fibrous, and the cartilaginous "granulations" are therefore to be considered as healed tubercles. Further investigations upon this point are "as necessary as important."

Whether tubercle is capable of resolution, undergoing fatty degeneration and absorption, without affecting the tissue in which it lies, is not yet proved, although held to be possible by Virchow and Rokitansky.

Direct ulceration of miliary tubercles is frequent, especially in the larynx; they soften and ulcerate without first undergoing cheesy degeneration.

But by far the most frequent termination of miliary tubercle is its transformation into the yellow cheesy matter. It is a remarkable illustration of the confusion of doctrine which has prevailed, that even upon this important point there has been wide diversity of opinion. Andral, Reinhardt, Empis, and Rokitansky are arrayed against this view, although not agreeing upon other points. But the change has been so conclusively proved by Laennec, that scarcely anything can be added by later times to his argument.

> "To every one not under the influence of some theory, Laennec's explanation of the facts will appear the simplest and most impartial; while, on the contrary, that of his opponents will appear forced and formed to agree with a pre-formed hypothesis. But Laennec himself is not free from blame for the origin of this conflict, since he laid down the proposition that all yellow 'tuberculous' matter must have proceeded from the gray substance. It was not difficult for his opponents to meet this statement; there were palpable facts from which could be shown a direct origin of yellow tuberculous masses which had not previously been gray tubercle. But now these facts were too widely generalized, and the transformation of the gray into the yellow tubercle was denied even for those cases in which unprejudiced observation was obliged to admit it. For us, who no longer call everything which is cheesy tubercle, the original conflict has lost its early and principal importance. We are far from claiming that all cheesy matter has been formerly gray and must have proceeded from tubercle; we recognize fully the possibility of its having very various origin; but we must, also, as concerns real tubercle, maintain Laennec's doctrine in its fullest extent, that the gray tubercle, generally first in the centre, and then gradually towards the circumference, changes into the yellow cheesy tubercle."

This yellow tubercle, the product of gray, exhibits the microscopic appearances generally given—the tubercle corpuscles with finer elements, molecules and granules. The corpuscles have been proved by Reinhardt and Virchow to be "not primary formations but shrivelled cells." The difficulty of determining in every case what is really true tubercle and of distinguishing it from the product of caseous inflammation is admitted; it is a point which has been urged by Lebert, but because it is sometimes difficult we should not, therefore, generally, or whenever possible, make the distinction; in the early stages it can always be made, and, besides, "even if two processes yield similar or perfectly identical products, we are not thereby justified in considering the processes themselves as identical."

As to the further fate of this pathological product, its absorption has not been proved, is improbable, but, according to Rokitansky and Virchow, its possibility cannot be denied.

It very frequently undergoes cretification or petrifaction, and is either encapsulated or thrown off by ulceration, recovery being the result.

By far the most frequent changes, however, is softening. Yet in the changing phases of doctrine even this "unimpeachable fact" has not been left unassailed, and upon this point we quote a suggestive paragraph or two the bearing of which will be better seen hereafter :—

> "It must, indeed, be confessed that the softening and ulceration of products resulting from miliary tubercle can be but rarely proved with *positive certainty.* If an ulcer or a cavity be found, and in its neighbourhood miliary tubercles, it is generally concluded that the softened and broken-down mass likewise resulted from tubercle. But how can the objection be met with positive proof that the

> ulceration may have resulted from an inflammatory process, and that the miliary tubercles are only secondarily developed in its neighbourhood? Why do we find so extraordinarily seldom—according to some authors, never—softened and ulcerated tubercles in the serous membranes, if the termination is the ordinary one, while in the lungs and intestinal canal, where there is a possibility of another explanation, ulceration is so frequent?
>
> "By most authors it is, indeed, now admitted that by far the majority of the cavities found in the lungs of consumptives are the result of caseous pneumonic processes. So too the intestinal ulceration may depend upon follicular inflammation, and the tuberculosis on its borders be a secondary process."

There has always been a division of opinion among pathologists as to the point at which softening begins; one leading doctrine has been that it was the centre of the tubercular mass, another that it was in the tissues surrounding it. The author thinks the proof of the former irrefragible. Cruveilhier is the champion of the opposing doctrine whom he mentions, but it has been sustained among us by the high authority of Carswell. A microscopic examination of the softened tubercular mass, "which has been falsely called tubercular pus," shows nothing but a detritus besides the shrunken cells called tubercle corpuscles. There is no growth of young cells—

> "This circumstance forms an important proof against Cruveilhier's doctrines and establishes the fact that softening does not result from a new cell formation but upon a necrosis and ruin of cells."

Pus cells are only found when the surrounding tissue is affected or a bronchus has been opened.

By softening is occasioned a defect in the organ, an abscess with constant inclination to spread by new deposit of tubercle in its walls, and further breaking down of tissue. Yet with favourable opportunity for emptying itself externally an effort is set up towards repair, and cicatrization may actually follow. The author refers to Laennec as speaking of the very great frequency of such cicatrices being found, and to the statement of Cruveilhier that it is very seldom the lungs of adults and aged persons are found without traces of such healing process about the apices. In the historical portion he gives Carswell the credit of having particularly described the healing process of phthisical lungs, and says that "pathological anatomy has never given stronger proof of the curability of any disease than of consumption." We may also here quote Bennett's statement that "tubercle is arrested spontaneously in one-third of all the persons in whom it occurs."[1]

> "Although we may admit that among these lung cicatrices and healings of tubercle by far the greater portion were the result of cheesy inflammatory deposits and not of true tubercle, yet it is, nevertheless, certain that tubercular ulcers and cavities may also heal. *I have been able to follow, by daily laryngoscopic observation, and, although relatively seldom, yet in single instances with certainty, the healing of tubercular ulcers of the larynx.*"

But the great point of obscurity in our knowledge of miliary tubercle is as to its origin, the great question of to-day, the answer to which pathologists are impatiently awaiting, is—"are miliary tubercles a new formation *sui generis* or a product of inflammation?" We have seen the difference of opinion among authorities; in opposition to the inflammatory origin stand Bayle, Laennec, Louis, Virchow; on the other side Broussais, Andral,

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[1] Practice of Medicine, 3d Amer. edit., p. 183.

Cruveilhier, and Reinhardt; while Lebert, originally with the first party, has changed over to the second. The opponents of the inflammatory origin plead the peculiar character of the bodies, so different from any recognized product of inflammation; they adduce the frequency of their occurrence without a trace of inflammatory action, and look upon it when present as a consequence of the tubercle irritating the tissues like a foreign body. On the contrary, the other party holds the presence of inflammation to be the normal condition, and looks upon tubercle without it as evidence of a terminated process; they admit the peculiar appearance which likens the tubercle to neoplasms, but will not admit that this proves them not possibly of inflammatory origin; Andral and Reinhardt of this party claim to have observed the miliary tubercles in an early stage of existence, a soft gelatinous condition.

In view of the possibility of inflammation yielding products other than those usually recognized, of the obscurity which yet hangs over the process of inflammation itself, the author leaves this question here undecided, and, especially in view of Cohnheim's discovery, thinks the whole question as to tubercle being an exudation must be examined and discussed anew.

Having traced miliary tubercle through its changes from gray to yellow, the author next considers that kind of yellow matter, generally known as "yellow tubercle," which has a different origin—"cheesy products not originating in miliary tubercle." This kind of matter is not tubercle at all, a fact to be carefully kept in mind by the student who has followed writers by whom the yellow is termed "true" tubercle, and by whom no distinction is made between yellow matters having a different origin. That this yellow cheesy matter is not tubercle is now, we are told, a "recognized fact as uncontested as any other in pathology." Andral first showed that simple pus in old abscesses would undergo thickening and become "tuberculous"—*i. e.*, take on this cheesy consistence and appearance; Reinhardt proved that the so-called yellow tubercle of the lungs and other internal organs might have the same origin; Virchow confirmed these views, and showed that cancerous tumours and various other pathological products undergo the cheesy degeneration. The yellow cheesy matter generally described as "yellow tubercle" is not then tubercle, but is an inflammatory product—

> "I will here only bring forward a single fact which bears with overpowering weight upon the whole subject. There are certain species of animals in which every simple abscess has the inclination to this cheesy change. At the head of these animals stands the rabbit. If we injure one of these externally with sufficient violence to cause suppuration, there collects at the injured spot a purulent deposit which seldom opens outwards, but remains encapsulated under the skin. If this abscess be opened it contains no fluid pus, but a more or less thick matter of cheesy consistence exactly resembling the yellow tubercular matter. That in this case we have to do with true pus and not with tubercle is without doubt, and needs no further proof. It is, therefore, a matter of course that every one who uses these animals for experiment in regard to tubercle should not only recognize this fact but distinguish between cheesy matter and true tubercle, otherwise almost every rabbit will be considered tuberculous."

The yellow matter is found principally in the lymphatic glands and in the lungs. The changes in the former from simple hyperplasia of the lymphatic elements, or from simple inflammation, are traced but need not detain us; externally, these affected glands are the sign of scrofula; internally, they cause "bronchial phthisis," or "mesenteric scrofula," but protest is made against such terms as "tuberculosis" of the mesenteric or bronchial glands. In the lungs these cheesy deposits show a marked preference for the upper lobes; the larger ones are diffuse, non-isolated, have no nodular projections from their exterior, are often surrounded by traces of inflammatory action, and in general as well as in particular give no evidence of an origin by confluence of smaller bodies like miliary tubercles. So markedly is this the case that the term "infiltrated tubercle" has been applied to them by Laennec and other authors who have recognized the difference in form but not in essence. Yet the difficulty of distinguishing this matter from the yellow tubercle—the product of miliary—is acknowledged to be great; to ordinary examination it is impossible :—

> "Also microscopically the appearances are strikingly similar; in the earlier stages of the cheesy hepatization the unchanged pus corpuscles scattered through the whole structure can be plainly recognized, but in more advanced stages of inspissation the pus corpuscles are, for the greater part, shrivelled into the same bodies which, in yellow tubercle, are known as Lebert's tubercle corpuscles. . . . . If the process of retrograde metamorphosis be still further advanced, all criterion of a differential diagnosis is destroyed. The cheesy pneumonic deposits go through the same changes as yellow tubercle; at the best they can become cretaceous, but generally they soften from the centre towards the periphery, vomicæ are formed which empty themselves externally, the softened masses are eliminated, and the cavities heal by cicatrization or by the formation of fibrous sacs."

But if the difficulty of distinguishing the larger cheesy deposits from tubercle is great, it is still greater in regard to the smaller which occupy the alveolæ of the lungs :—

> "These alveolar deposits may be, like tubercles, very small, the size of millet seeds; also circumscribed and isolated, so that even the most experienced observer may be in doubt as to a decision. It may, with full right, be maintained that many of the principal authors have used these small cheesy deposits as patterns for their description of miliary tubercle, and yet they are nothing but thickened pus. The cheesy mass here fills entirely the alveolæ and the cavity of the smallest bronchia; frequently the matter may be pencilled out and the bronchial walls left free again. If gray tubercles are not to be found in the surrounding parenchyma, or more remote, the diagnosis is rendered easier; if, on the contrary, true tubercles are combined with these deposits the decision is frequently, in individual cases, impossible."

We must give now the author's nomenclature dependent upon these pathological views. Tubercle and cheesy pneumonia both cause phthisis or "consumption." There is a form of phthisis caused by miliary tubercle alone, uncomplicated with any cheesy deposits whatever; this is "*pulmonary tuberculosis*," and is "one of the greatest rarities," for the tendency to complication is great. Far more frequently is cheesy pneumonia alone the cause of phthisis, and attacks of it are "the beginning of the disease in the great majority of cases;" this is *phthisis simplex*. As soon as symptoms indicate that tubercular deposit complicates this form the term *tubercular phthisis* is applied to the disease. "In many cases a differential diagnosis can be made during life, may even be easy, and at least it is always useful to attempt it. In many cases, on the contrary, it is difficult or even impossible."

What are the causes of this cheesy degeneration, or *tyrosis?* (to use the Greek word, which, perhaps, had better have been adopted). The question bears very closely upon the etiology of scrofula and consumption, and is therefore of the highest importance, for it must be remembered that the consumption dependent upon cheesy pneumonia is held to be by far the most frequent. In his answer to this question the author takes the ground that this tendency to tyrosis is a *local* rather than a *constitutional* affection. The constant result of traumatic irritation in rabbits[1] is admitted as a strong argument in favour of the constitutional view, but that in man there is ever a general tendency to cheesy degeneration of pus in whatsoever part of the body formed is denied. The tyrosis shows itself almost universally in the lungs; it is therefore local, and we are to look to local causes for its existence. An abnormal structure of the thorax and consequent interference with the function of the lungs may possibly explain this disposition to tyrosis, but the impossibility of pointing out the particular deformity is admitted. The narrow and constricted chests of consumptives must interfere with the flow of blood through the lungs, and the question is started whether a certain relative dryness, or want of blood in the parenchyma may not account for it. In connection the small quantity of water consumed by the rabbit, the scantiness of its urine, and hardness of its feces are commented on as facts possibly bearing on the point. He then considers Rokitansky's doctrine, that cyanosis or venosity of the blood caused by mechanical affections of the circulatory and respiratory organs affords an immunity from phthisis, and the various instances are adduced. Traube, too, holds that diseases of the heart afford an immunity to caseous pneumonia, but only those diseases "in which the exit of the blood from the pulmonary veins is in great degree hindered and in consequence of this a transudation of the serous part of the blood into the pulmonary parenchyma is favoured." It is an important fact, too, that, on the other hand, a congenital constriction of the pulmonary artery gives a marked predisposition to pneumonia with cheesy deposits. Reference is given to other authors besides Traube, who have observed and noted the frequent connection of pulmonary consumption with stenosis of the pulmonary artery; they are Farre and Travers, in 1815; Gregory, 1822; Louis, 1826, and more lately, Frerichs and Lebert. From all the facts it appears that

> "This combination is not an accidental one, but that in fact individuals affected with a constriction of the pulmonary artery, or of the mouth of the same, are markedly disposed to pulmonary consumption, while the percentage of those dying of this disease among those affected with this lesion is uncommonly great."

Among the cases of this kind reported there were twelve in which a high degree of cyanosis was present; consequently it cannot be the cyanosis which affords the immunity to phthisis; the hindered flow of blood to the lungs would rather seem to be the causative circumstance, and numerous instances are adduced to show that whatever favors a flow of blood to the lungs affords protection from consumption, and *vice versâ.*

> "The surprising rarity of phthisis among high mountains is explicable according to our hypothesis. By the influence of the lessened atmospheric pressure, and the increased lung action consequent upon ascending heights, the flow of blood through the lungs must be increased. These men easily acquire acute pulmonary inflammation, but the products of it, on account of the fulness of the lungs with blood, manifest but little disposition to undergo caseous degeneration."

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[1] The author admits that abscesses, containing very thin putrid pus, are sometimes formed in these animals, but only when putrid matters have been introduced into the wound, or after great and long-continued irritation.

What is now the explanation of scrofulosis? Why do diseased glands in scrofulous persons undergo cheesy degeneration, while in healthy subjects they undergo resolution, or yield laudable pus? The answer shows a belief in a local rather than in a constitutional cause.

> "Scrofulous persons have simple abscesses, with fluid pus close to cheesy lymphatic glands, and frequently enough pulmonary inflammations running a normal course, so that no general disposition to tyrosis is perceptible. This process remains limited to the lymphatic glands."

Scrofula, then, is a "constitutional anomaly in which the lymphatic glands have an abnormal tendency to disease, and possess a local disposition to undergo cheesy degeneration."

We may thus briefly sum up his doctrines upon cheesy degeneration, or tyrosis. It is a peculiar change, especially liable to occur in certain *parts*, as the lungs; its occurrence there is opposed by any malformation or disease of the chest, heart, or arteries which promotes a damming up of blood in the pulmonary parenchyma, and *vice versâ*. Certain pathological products are especially liable to undergo this degeneration, as tubercle, enlarged lymphatics, and the diseased intestinal and mesenteric glands of typhus; the cause of the change is local rather than constitutional.

> "Wherever tubercle and the typhous glands appear, let the constitution of the individual be what it may, these structures will, from their own nature, undergo tyrosis, *i. e.*, the disposition to the degeneration is in themselves, not in the constitution of the affected person."

The questions which yet remain open in regard to tubercle, and especially in regard to the connection between it and caseous pneumonia, and the relation of both to scrofula, are numerous, important, and intricate. Some of them, it is to be hoped, may be solved by the information derived from the inoculation of tubercle; and to this subject the third section of the book is devoted. It opens with an historical sketch of experiments in this direction, and, German-like, begins with the first investigations made in studying the contagiousness of scrofula, and gives every step in the progress of our knowledge since, from the accidental inoculation of Laennec's finger to the latest investigations, and including all that has been done in the study of glanders, embolia, and other diseases. It is not necessary for us to go farther back than Villemin. The presentation of his memoir to the French Academy in December, 1865, marked, as before said, a new era in the subject, and not alone by the addition it made to our knowledge, but also by the new zeal and interest it awakened in the study of the subject, and which has already carried us far beyond the advance point then reached. In this memoir, and in a complete work[1] published in the winter of 1867–8, the following propositions were laid down:—

1. Tuberculosis is a specific disease.
2. Its cause resides in an inoculable agent.
3. The inoculation of rabbits from man readily succeeds.
4. Tuberculosis belongs, consequently, to the zymotic diseases, and should be classed nosologically with variola, scarlatina, and syphilis; better still, with glanders.

In making the experiments upon which these propositions are based, he used indifferently miliary tubercle and the infiltrated matter of cheesy pneumonia, calling both "tuberculous." But one important point remained yet incomplete. Villemin was justified in pronouncing tubercle inoculable, but it remained to be shown whether tubercle alone, and nothing but tubercle, would produce tubercle when inoculated. Our author says that he contented himself with but few experiments upon this point, and consequently laid down the doctrine that tubercle is a specific affection, most closely allied to glanders, producible alone by a virus, which must be inoculated, inhaled, or introduced into the system by contagion, and denied hereditary influence, constitutional disposition, pneumonias, catarrhs, and hæmoptosis as causes of consumption. To Villemin everything that produced tubercle by inoculation was tubercle; the caseous matter of pneumonia and of diseased glands gave successful results in experiment, therefore they were "tuberculous." But the range of his experiments had not been wide enough ; a fact of prime importance had escaped him ; one more interesting of itself alone, more influential upon doctrine, and more important practically than any with which he had astonished the scientfic world. This fact is, that the inoculation of many other matters besides tubercle, matters of the simplest kind, and which must act mechanically alone, will produce tubercle. Its mere statement shows its importance; the wide field of inquiry opened is revealed at a glance; in the brief period which has elapsed since their publication Villemin's labours have become but a stepping-stone in our path of progress. We commend this striking fact to the careful consideration of those who, perplexed by the conflicting doctrines which have succeeded each other, and forgetful of the intricacy of the subject under investigation, have been tempted to sneer at the uncertainty of medical theories, as well as to those who, looking only at what remains yet unknown, would despair of further effort. Scarcely were the sheets which presented Villemin's discoveries to the scientific world dry from the press, before pathologists were submitting them to examination by experiments, which were varied in every possible manner, and by which the chief result obtained by him, the inoculability of tubercle, was confirmed, but his doctrines, in many respects, shown to be untenable, and great and unexpected additions made to them. In Germany, Lebert and Wyss; in France, Colin, who headed the commission of the Academy to examine Villemin's memoir; in England, Andrew Clark, Simon, Sanderson, and Wilson Fox, were the principal ones who followed up the work. The three latter fully established the important fact that not only the inoculation of matter other than tubercular would cause tubercle, but that a long-continued traumatic irritation, as a seton, also gave rise to it. Upon this fact Fox bases views as to the cause of tuberculosis identical with those which the author says he himself had published six months previously.

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[1] Etudes sur la Tuberculose; preuves Rationelles et Experimentales de sa Spécificité et de son Inoculabilité. pp. 640. Paris: Baillière, 1868.

In the brief sketch of the important results gained by experimental inoculation, we have anticipated the subject so far as our author's labours are concerned. His own experiments began in January, 1867, first to test the specificity of tubercle set forth by Villemin, but continued with a rapidly extending plan as new facts were observed. They were so numerous, of such character, so well conducted, and with such results as fairly to rank him among those whose names have been mentioned, and to whom we are indebted for much important advance in our knowledge. The details of his experiments occupy over one hundred and fifty pages of the book ; to attempt any detail of them is impossible here, yet some statement of their extent and character, and of the results gained, seems necessary to an understanding of the concluding portion of the work. We will merely sketch them as they are classed in series.

FIRST SERIES: *Inoculation with fresh and softened gray miliary tubercle.*—Number of animals experimented on, 20. In 12 of these the inoculation failed entirely, a strikingly large proportion. Of the 12, 10 died in from two to ten days of septicæmia. In the 8 successful cases tubercles were found, and generally in more than one organ, and "tubercles that both macroscopically and microscopically showed the most perfect analogy with the miliary tubercles of man." A critical examination of the experiments gives prominence to the following points:—

A lack of correspondence between the local and the general affection. In the best marked cases of tubercle in the internal organs, not a trace remained at the point of inoculation.

The necessity of a certain duration of life for the production of tubercle after the inoculation seems to be shown by the results; yet there is no constant relation of this kind, as the following series will show. Ten days may be looked upon as an unusually early period for the affection of internal organs, and "only in rare cases will the general affection take place before the third week."

The successful cases followed, in by far larger proportion, the inoculation of softened tubercle.

SECOND SERIES: *Inoculation with the products of cheesy pneumonia and pus from the cavities of consumptives.*—Number of experiments, 5. Result negative, the animals dying in every instance within ten days, of septicæmia or pleuro-pneumonia. The limited number of this series is regretted by the author, but arose from the difficulty of obtaining inoculable matter from cases in which there was known to be no tubercular complication; but the possibility of successful inoculation of cheesy material has been meanwhile established by other experiments, as below:—

THIRD SERIES: *Inoculation with the non-tuberculous cheesy matter of lymphatic glands extirpated from a living person.*—These experiments were to afford a crucial test for the decision of the question, whether miliary tubercle could be produced by inoculation of cheesy matter alone, and certainly not tuberculous in the sense the word is used here. Septicæmia was not to be feared, and the objection of a post-mortem infection could not be advanced against them. Seven experiments: one died of pneumonia in fourteen days; two negative results; four not only successful but "brilliant." In all the liver was full of miliary tubercles, in three the lungs also, in none was a single organ alone affected. The following points are impressed:—

Entire want of local affection to account for the general infection.

The impossibility of discovering any difference between the tubercles produced and those of the first series.

A frequency of success by inoculation of this scrofulous matter rather above that obtained with tubercle.

The destruction of all foundation for the objections that the results of inoculation are due to introduction of post-mortem matters, or to pyæmic processes.

FOURTH SERIES: *Inoculation with thickened pus from the inoculated point of an animal already inoculated either with tubercle or cheesy matter.*—This series was undertaken because, according to Villemin, the abscess forming at the point of introduction is tubercle; the author could see only, in the few cases in which it occurred, the thick cheesy pus which always follows traumatic irritation in rabbits. According to Villemin, too, the local irritation bears to the general affection the same relation that chancre does to syphilis! Of the eight experiments, two were negative, and six successful. But besides mere success as to tubercle, other effects were produced which the author deems important.

In the two cases in which no tubercle was found, there was marked hyperæmia of the internal organs, generally with evident disposition to the formation of cheesy-purulent deposits; in one of them centres of hemorrhage in the lungs, fibrinous clots in the heart. In the six successful cases, in addition to the tubercles, there were evidences of internal inflammations—pericarditis, and myocarditis, swelling of cervical glands, and hemorrhagic centres in the lungs. In four of the cases, the miliary tubercles were found only in the liver, and it is remarkable that in two of these, not more than five days had elapsed since the inoculation.

> "We believe ourselves justified, nevertheless, in direct consideration of the post-mortem results, in ascribing the liver affection to the preceding inoculation. *The diseased process in both these cases was evidently much fresher* than we have ever observed it in any other cases. In the animal which died four days after the inoculation, *the origin of the whitish nodules, here very fine, just visible points, could be seen in the plainest manner within numerous small circumscribed centres of inflammation or at least hyperæmic areas.* In the animal dying on the fifth day there were also extraordinary small white points present, but the inflammatory areola around them was much less plain."

FIFTH SERIES: *Inoculation with pathological products non-tubercular in character*:—

a. With cancerous matter. Five experiments, all negative, except the local results which do not concern us here.

b. Two experiments with the hepatized lung substance of a person who died of "croupous" pneumonia, and

c. Three with catarrhal sputa yielded negative results, the animals dying with symptoms of intense blood-poisoning.

d. Subcutaneous injection of pus. Three experiments with human furuncular pus; all died of pyæmia. Then to procure healthy animal pus, issues were made in a rabbit and a guinea-pig, and the pus of these used. Of three rabbits injected, all failed; of three guinea-pigs, all were successful, and showed "miliary tuberculosis of the lungs, liver, spleen, kidneys, and some glands in high degree." In two of these, the author feels assured that he found miliary tubercle in *process of healing*. It took place coincident with return of warm weather and green food, and increase of flesh and improved appearance followed the evidences of severe illness, as he has observed it to generally follow in animals on the return of spring; they had to be killed for the examination, and the evidences of healing were, a deposit of pigment in the neighbourhood of the lung tubercles, and in a cartilaginous change, or fibrous metamorphosis, while softening was not to be found in any.

> "The larger cartilaginous, pearl-gray nodules are in every respect analogous to the granulations which are not seldom found in the lungs and in the serous membranes of subjects dead of any disease whatever, and which are often combined with true tubercles. From the result of the examination of these animals, it is in the highest degree probable, indeed even certain, that the cartilaginous granulations formed in them were healed miliary tubercles, and that consequently a cartilaginous transformation is one process of healing in tubercle."

These facts seem assured from the results of experiment thus far: —

Tubercle is produced, not merely by inoculation of tubercular and cheesy matter, but by introduction of matter certainly not tuberculous.

Successful inoculation, however, follows the introduction of miliary tubercle and the cheesy matter of lymphatic glands, much more frequently than other substances.

The development of the general tuberculosis bears no relation to the local effects of inoculation.

SIXTH SERIES: *Inoculation with tubercle and cheesy matter taken from preparations which had lain several months in alcohol.*—The results of such a class of experiments would, of course, decide the truth or falsity of Villemin's assumption that inoculation depended upon a virus, and that the inoculated material must be fresh; they would also settle any question relative to inoculability depending upon a vital property, such as cancer-cells may be presumed to possess. The success attained was beyond expectation: of six animals one died without any result in sixteen days, all the others were markedly affected, and in most of the internal organs; there was no local irritation at the point of inoculation, and no septicæmia excited. The fact was firmly established that the substance preserved for months in spirit was equally efficacious with fresh tubercle; but to meet any possible objection which might be raised as to a chemical infection matter other experiments were made.

SEVENTH SERIES: *Inoculation or subcutaneous injection of tubercle or cheesy matter submitted to intense chemical action.*—The substance inoculated was submitted to the action of fuming nitric acid, boiling-water heat, or in some cases of permanganate of potassa or chromic acid. Of six experiments three gave a negative result; of the three positive, the effect was limited, thus the lungs were free in all, yet other organs were sufficiently affected to establish the efficacy of the inoculation of matter thus chemically acted upon.

But from this series the author claims to derive very important support to his peculiar views. All chemical influence, all animal virus must have been destroyed, therefore

> "The substances must have produced their effect alone by their structure, their unchanged morphological constitution of very minute elements. These elements, although changed by intense chemical action, retained, as the microscope proved, their external form, only somewhat shrivelled. Briefly expressed —*matter morphologically* (*or physically*) *the same, although thoroughly changed chemically, acts the same as the original matter.*"

This view being taken the negative results of this series become instructive. Thus in two of the experiments the substance from lymphatic glands was so acted upon by fuming nitric acid as to become almost entirely soluble, its corpuscular elements were entirely destroyed, and the results were negative. Another case in which the same substance was used the result was positive, but in this one an abscess with cheesy pus formed at the point of puncture.

> "It is thus possible that not the inoculated substance itself, but the cheesy pus produced by its irritation, its particles being absorbed, causes the infection."

Upon this failure of the inoculation of non-corpuscular, and success of corpuscular matter, however much changed chemically, he lays great stress.

EIGHTH SERIES: *Inoculation or subcutaneous injection of chemically* *changed non-tuberculous substance.*—Four experiments, three successful, and with a success exceeding all others. The matter used was muco-purulent sputum of a person suffering from chronic pharyngitis, but otherwise healthy, thus with not a trace of tubercle or anything resembling it. The success was striking because the extent to which the internal organs were affected, and the different forms of affection, exceeded all other cases witnessed. Thus one animal had miliary tubercles in lungs, pleura, pericardium, peritoneum and omentum, liver, kidneys, spleen, lymphatic glands, heart, and pia mater; also cavities in the lungs, spleen, and in one lymphatic; one eye was affected with suppurative keratitis, iritis and perforation of the cornea, the other had miliary tubercles in the choroid coat. In another subject of experiment, were extensive cheesy hepatizations of both lungs, and with them miliary cheesy deposits. A good deal of space is occupied with the details of this series, and we can do little more than indicate the character of the results.

NINTH SERIES: *Introduction of coloured substance.*—This series was begun with the use of tubercular matter coloured so as to test the possibility of thus tracing it, and continued by the use of the colouring substance alone, and of these, aniline blue is by far better adapted for experiment than indigo or any other. This is the largest series of all, and we can only make a few extracts from the summing up.

> "Glancing first over those experiments in which tubercle or cheesy matter was introduced in intimate mixture with aniline blue, the important fact presents itself, that in the miliary nodules excited by inoculation, the presence of the colouring matter was most evident. Since the aniline blue was not in solution, but in corpuscular form, so it is proved that such elements introduced into the subcutaneous tissue are carried to and deposited in the various internal organs.
>
> "The vague assumption of some contagious juice which is absorbed cannot be made to explain the operation of tubercle inoculation, *but it is established that the inoculated elements as such, either by the lymph or the bloodvessels, can be taken up and carried to the different parts of the body.* It is further *ad oculos* demonstrated *that the corpuscular elements of the inoculated matter are found in the artificially produced tubercle.*"

Considering the objections that may be made, he nevertheless believes that—

> "The corpuscular elements taken into the blood from the inoculated point are the only and true cause of the formation of miliary tubercles in the various organs.
>
> "It is also established that the coloured elements found in the tissues have passed out of the bloodvessels, for they only could have arrived at the different organs by means of the vessels, either lymphatics or principally bloodvessels."

TENTH SERIES: *Inoculation or injection of blood.*—These experiments consisted partly in subcutaneous injection, and partly of injection into the trachea, the blood being of healthy animals, and either fresh or boiled. They were undertaken to see if blood, other than that of a consumptive, might not produce tubercle, and in this seem to have been successful; also to investigate the influence of hemorrhages into the lungs. Besides the influence in producing tubercle, a decided tendency to intense inflammation with cheesy deposit, and to local pulmonary hemorrhages was manifested.

> "The gray-white points and nodules within the hemorrhagic centres in the lungs deserve very particular attention; they are the beginning of miliary bodies—whether of inflammatory or tubercular nature remains undecided—which occur in company with extravasations of blood."

ELEVENTH SERIES: *Traumatic irritations.*—Four experiments of this kind are given, all failures, yet he admits the positive results obtained by Sanderson and Wilson Fox outweigh any amount of negative results.

> "Only this much may be probably justly maintained, that the production of tubercle by traumatic irritation is not a usual occurrence, but, when it occurs, must be considered a rarity."

The brief sketch we have given will suffice to show the character, range, and results of the author's experiments, as well as to indicate the direction in which they are leading him. His summing up and general consideration will of course present his views more fully. The sources of error seem to have been carefully considered; he claims that by long-continued helminthological investigations and minute study of inflammation he has become familiar with every nodule and particle likely to be mistaken for tubercle; there are many such, most of them entozoa, and some have deceived experienced observers, so that he lays it down as an absolute rule that no body should be accepted as tubercle in these experiments until the microscope has confirmed the other modes of examination.

He considers at length the question, "Are the artificially produced nodules really miliary tubercles?" We shall not follow him because so many independent observers have arrived at the same conclusion, that the fact has been established, and the question needs no controversial examination. If Virchow, not only in private, but in his public lectures, accepts these bodies as tubercle, we may consider the question as definitely settled.

But are these tubercles really the consequence of the inoculation, or are they not rather accidental formations? This is an important query; one upon which hinges the whole subject. Those who claim that tubercle is of frequent occurrence in animals, are those who look upon the cheesy matter as tubercle; we have seen that the author is not one of these; he carefully distinguishes between the two substances, and he and all authors who thus distinguish do not believe in the frequent occurrence of tubercle in animals.

> "A true miliary tuberculosis in animals either does not occur at all, or at least is one of the greatest rarities. Virchow declares expressly in his work on tumours *never* to have seen gray miliary tubercle in them, and scarcely any one has had greater opportunity for observation than Virchow."

His own observation corresponds with this. In all the animals he has examined, looking out every nodule and point for parasites and entozoa, he never found miliary tubercle. Animals are termed tuberculous "from the confounding of terms already so much dwelt upon."

Villemin kept his inoculated and non-inoculated animals in the same cage, and under perfectly similar circumstances; the one had tubercles, the others were always found healthy.

Farther, those animals inoculated by the author which died of septicæmia had no general tubercular infection; some of them certainly would have had, were their occurrence dependent upon mere accident.

The number of the author's experiments was 104, and there were used 71 rabbits, 28 guinea-pigs, and 3 horses. Of 100 experiments, 34 gave positive, 9 doubtful, and 57 negative results. Without going into particulars, we may give the following lessons of the percentage:—

> "1. Inoculation with non-tuberculous and non-caseous substances, such as chemically changed catarrhal sputa, is not less successful than with tubercle

> and cheesy matter; 2, inoculation of substances such as aniline blue, carmine, and blood, produces tubercle, but in general far more seldom than tubercle, cheesy matter, sputa, and pus; 3, that success is most seldom—in our own experience never—with simple traumatic irritation and carcinoma."

The relative frequency with which the internal organs are affected is different in animals from man, the liver heading the list; thus the liver was affected 26 times, the lungs 21, the intestines 14, mesentery 12, spleen 11, kidneys and lymphatics each 10 times.

Re-stating the facts obtained by the experiments he asks the questions how these tubercles are produced? what *common element* is there in these varied substances to produce a common effect? It cannot be a virus, as Villemin held, for the substances are too heterologous; it cannot be a chemical property, or a contagious vital liquid.

> "The common element is to be found most simply in their *morphological constitution.*
>
> "All the substances efficient as inoculating agents agree herein, that, as shown by the microscope, they consist of very fine formed particles which are smaller, or at least not larger than the colourless blood corpuscles, that they thus consist of elements which can circulate with the blood without causing embolia or stoppage of the vessels."

Looking at the facts—especially at the fact, indubitably proved, that coloured particles thrown into the subcutaneous tissue are found in the internal organs with tubercle—he cannot escape the conclusion that thus do the particles of all inoculated substances enter the blood, are deposited and cause tubercle.

> "It is proved that the fine corpuscular element is as such absorbed and enters into the blood. It is farther proved that these elements are afterwards to be found in the various internal organs. Finally, it is proved that the artificially caused tubercle contains in itself the morphological constituents of the inoculated material."

The first objection to this theory is that general tuberculosis follows the introduction of such substances as cotton wool, or a seton, as in Wilson Fox's and Sanderson's experiments, and the consideration of this leads to the statement of a very important part of his views:—

> "In all these cases there was present a local suppuration as consequence of the traumatic procedure. This secondarily produced pus could be as well absorbed as the substances consisting of fine elements in the inoculated animals. There is therefore no proof against our theory in this, much rather may the results of these experiments be shown to be in harmony with it. In all these cases in which tuberculosis followed a pure traumatic influence there was a *self-infection.* We must thus far extend our theory: *that not only a foreign substance made up of fine particles, and introduced from without, can cause the production of tubercle, but also fine corpuscular elements present in the body, or abnormally produced in it, may have the same effect.* This very fact of self-infection is extraordinarily important in order to clear up the etiology of tuberculosis in man, as we shall see."

Is tubercle an inflammatory product? This question was postponed, as we have seen, until it could be viewed by the light derived from experiment. Can it be answered now? To reply would necessitate an answer to another—what is inflammation? According to the author, we do not yet know the chief point of this process; seemingly settled but a short time previously as in the tissues, by Cohnheim's discovery it has been carried back again to the vessels, and the whole subject once more thrown into "violent fermentation." But Cohnheim's discovery refers to the acute process alone; how is it with the chronic, the products of which in some instances much more closely resemble neoplasms? The results of experiment differ; in some of the animals an exquisitely well-marked inflammatory areola surrounded the miliary tubercles, while generally these bodies show no trace of vascular action. Which is the beginning and which the terminating process? He is of opinion, that experiment will yet decide this question, and his suggestion to study the age of tubercle by injection of different colouring matters in succession at different periods of time seems well adapted to solve it. At present he looks upon the formation of tubercle as a process at least allied to inflammation—a deposit following an irritation and thus analogous to an inflammatory product.

> "Looking upon tubercle, then, as an irritative deposit, wherein is to be found we would ask, the real essence of tubercle, that which to it is alone peculiar?
>
> "The characteristics of tubercle, in my opinion, are, besides the lymphatic character of its elements, 1, its occurrence in miliary deposits; 2, that these are not single or limited, but occur simultaneously in numerous parts. These two characteristics are derived from the etiology of tuberculosis. *The essence of tuberculosis consists in its being an absorption disease (resorptions-krankheit), which owes its origin to the reception of very minute particles into the blood, and the presence of these particles is expressed by the occurrence of numerous scattered centres of deposit.*
>
> "*We thus seek the characteristics of tubercle less in the single nodules, but much rather in the general character of the disease.* According to this view, the single tubercles may be held to be products of inflammation or miliary abscesses; if only the general disease is made up of a general or at least a widespread occurrence of these miliary nodules of lymphatic character the essence of tuberculosis is assured.
>
> "According to this view we can lay no weight upon a scrupulous separation of the true gray miliary tubercles from other miliary deposits, especially from those yellow miliary nodules whose origin from pus or from gray tubercle is uncertain. Nature knows no systems; she never draws the rigid lines which render artificial systems presentable. Everywhere in nature we find transitions, which are difficulties for the heads devoted to systems, but which are necessary that unity may be assured throughout her dominion."

We are compelled to pass over many points of interest and proceed to the fifth section, the most interesting portion of the work: "The application of the results of experiment upon animals, to tuberculosis and pulmonary consumption in man." That his theory may not be misunderstood, we copy his re-statement of it in the following formula:—

> "*Miliary tuberculosis is an absortion disease; it originates from the reception into the blood of very fine corpuscular elements, and the deposit of the same with consequent nodule formation in numerous scattered points of the various organs.*"
>
> "Tuberculosis is consequently a *general* disease; in a certain sense it is also a *blood* disease, but it is not a specific affection. It stands in nosological classification in the nearest relation to pyæmia of all other diseases, which is also a non-specific absorption disease. Pyæmia, likewise, forms scattered centres of disease through various organs, but they are larger than those of tuberculosis, and are of inflammato-purulent nature. . . . . In tuberculosis, the elements are small and finely divided, and do not appear extremely irritating in character, wherefore, instead of pronounced or considerable inflammation, they give rise only to the formation of small miliary centres or foci."

To the support of this theory he devotes the section under consideration, and his first argument is derived from the fact that other men, studying the subject as pathologists and clinically, have arrived at views and stated theories very similar to those which he has derived from experiment upon animals. The particulars of these theories, both accordant and discordant, are given and commented upon. We can only briefly allude to them and their authors. The first is Buhl; he examined, of acute miliary tuberculosis, twenty-three cases, and in twenty-one of these found either cheesy infiltrations or cavities in the lungs; he has been led to look upon the latter as the cause of the tubercles, and calls tuberculosis "a specific absorption and infection disease." Hoffman has sustained Buhl in all except the specificity; he has proved that the cheesy deposits precede and cause the tuberculosis, and calls this "a disease consequent and dependent upon the accumulation of caseous detritus matters in the body." Dittrich's theory is said to have been more widely received; it attributes the disease to "the reception into the blood of the matters of retrogade metamorphosis, and a peculiar crasis produced thereby, especially an affection of the fibrous element."

Niemeyer has modified Buhl's theory in some important points, and his modifications approximate him nearer to our author. The quotations and references are to works of Niemeyer not so recent as are now accessible to the profession of this country. Since the seventh edition of his work on practice has been translated and published, we prefer to refer to that.[1] We will briefly state, then, that this eminent authority agrees with our author upon the following points:—

Hæmoptysis may occur without dependence upon tubercular deposit, either incipient or established; a contrary opinion is "altogether unwarranted, and fraught with danger to the patient."

Of all foreign bodies which, by irritation of the bronchial walls and air vesicles, give rise to consumption, the blood of a pulmonary hemorrhage most frequently has this effect.

A denial of the doctrine of Laennec that consumption is only of one form, and a distinct recognition of the fact that it is "much more frequently a result of chronic inflammation than of tubercular deposit."

The cheesy deposits, generally termed infiltrated tubercle, are not tubercular but products of inflammation.

The frequent coexistence of the two pathological products "suggests a causative connection" between them; "in a great majority of instances" the tuberculosis is a secondary process dependent upon the caseous deposit.

(That the caseous "infection-deposit" is not *always* found, is no proof, our author argues, that it does not exist, since it is found, when sought for, in so great a majority of cases.)

Predisposition to consumption is better expressed as "predisposition toward pneumonia, terminating in cheesy infiltration."

The origin of consumption in catarrh is distinctly recognized; "the wide-spread doctrine that consumption is solely dependent upon a diathesis" is "gratuitous and dangerous."

He thinks it "quite possible" that the danger of pulmonary tubercle from cheesy lymphatic glands will yet furnish an indication for the extirpation of all peripheral lymphatic tumours.

This support given to the author's views by others who have studied it in other modes, and which may be called the preliminary argument, having been detailed, he enters formally upon the statement of the proofs which are to be derived from 1, pathological anatomy; 2, pathology; 3, the etiology of the disease. These are three good pillars upon which to build any medical doctrine, and we must see if he can derive any support from them. Of course we can only select, in regard to each, some of the most important points.

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[1] A text-book of Practical Medicine, by Dr. Felix von Niemeyer, translated by Geo. H. Humphreys, M. D., and Chas. E. Hackley, M. D. New York: Appleton & Co. 1869. 2 vols. 8vo.

Support derived from Pathological Anatomy.—Under this head we shall confine ourselves to acute miliary tuberculoses. We find first the statement that all pathological anatomists agree that in an immense majority of cases there exists somewhere, most frequently in the lungs, centres of cheesy deposit; from these centres the tubercles have evidently spread, and by some it is maintained that those nearest the infecting centre can be seen to be older than those at a greater distance.

He quotes from Rokitansky, 1846, that this disease is but seldom primitive but generally secondary and dependent upon a previous deposit of tubercle elsewhere; and Rokitansky is one of those who includes the cheesy matter in the term "tubercle." He quotes to the same intent from the same author under date of 1855.

He quotes Virchow likewise. This eminent authority says, "If we examine closely enough we find almost always somewhere a cheesy nodule of ancient date," which is to be looked upon as the centre of infection. Very seldom indeed does a miliary eruption occur without a pre-existing caseous deposit.

He alludes to Buhl's cases already given, and to five carefully examined cases in Pfeufer's clinic, all of which were without exception.

In regard to acute tubercular meningitis he again quotes from Rokitansky, 1844, that it is extremely rarely a primary disease, but dependent upon disease in other parts. He finds also, in the observation of Tröltsch, that tubercular meningitis and even general miliary tuberculosis not rarely arise as secondary to purulent otitis, a strong fact in favour of his views.

The first *support derived from pathology* is the striking resemblance which exists between the course of acute tuberculosis and some of the "infectious" diseases, as typhus. "The clinical appearance of acute miliary tuberculosis is very often so similar to typhus that the differential diagnosis is impossible to the most experienced physicians."[1] In the one as in the other, there is evidence of a general blood poisoning, and the wide-spread formation of tubercles is like the eruption of an acute exanthema. This resemblance has been pointed out by clinical teachers who knew nothing of the recent experimental researches. The principal point for differential diagnosis has been heretofore the discovered presence of caseous deposits or cavities, and where none could be discovered our judgment could not advance beyond probabilities.

> "Now, however, we have learned, principally through Cohnheim, an almost certainly reliable means of diagnosticating general miliary tuberculosis during life by the ophthalmic examination of the choroid."

In regard to chronic tuberculosis he finds support to his theory in the different course and symptoms which consumption presents, which are sufficiently marked to justify division into three groups, readily recognized clinically.

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[1] "The symptoms [of acute tuberculosis] are so very like those of typhus that the most experienced diagnosticians acknowledge to having met with instances in which a diagnosis between the two was absolutely impossible, and when patients dying with a diagnosis of typhus really had died of tuberculosis, and conversely." —*Niemeyer's Practice.*

"Pulmonary consumption, as we have already explained, is not a simple disease—there are several forms of disease united under the term phthisis.

"The first form is the pure inflammatory, in which from beginning to end only the local processes of pneumonia, the cheesy thickening and softening of the products, are present, and true tuberculosis is entirely wanting. . . . . For this form we think the name of 'caseous pneumonia' or 'pneumophthisis simplex,' best adapted."

The second form begins, like the first, with acute or chronic inflammation and cheesy deposit, consequent upon the absorption of which tubercles appear, first in the immediate neighbourhood of the deposit and then more remote. "This form we term 'phthisis tuberculosa' or complicated phthisis."

The third form begins with miliary tubercles, secondary to pleuritic exudation, or affection of the lymphatic glands, or some other cause, and is called "tuberculosis pulmonum."

Clinically, these forms may frequently be recognized; as yet our knowledge is not sufficient to enable us to do it generally; Niemeyer alone has attempted a differential diagnosis between different forms of the disease.

We quote from the remarks on the third form a few paragraphs bearing upon the diagnosis of the complication of tuberculosis:—

"A certain criterion of the presence of miliary tubercles we do not possess. Pathology must strive to discover such a criterion, so important for diagnosis and prognosis. Whether Niemeyer's view that miliary tuberculosis manifests itself by a more continued, and pneumonic infiltration by an intermittent or remittent form of fever will be established in the future remains to be seen, so much the more since Niemeyer himself admits that his investigations are not yet closed."

"The diagnosis becomes more certain as soon as remote organs begin to be affected. If to the other symptoms obstinate diarrhœa is added, or an ulcerated laryngitis sets in, the presence of a secondary tuberculosis is in the highest degree probable."

"A want of proportion between the severe general appearances and the relative slight local signs on the part of the chest is the most important point forming a diagnosis between miliary tuberculosis and caseous pneumonia."

He devotes still more space to *the support derived from etiology*. The tendency of his doctrine is, as we have seen, to carry back, so to express it, the constitutional part of the disease from a direct connection with the production of tubercle to an indirect one. Tubercle is secondary to certain diseases to which certain subjects have a constitutional proclivity. These diseases are therefore of chief importance, and first among them stands pneumonia. Another important point is, that the mode of production shown to be most general in animals—the introduction of matters from without—cannot be so in man, and *self-infection* must be considered the chief mode in the human race. The cheesy material, whether originating in true tubercle or a product of inflammation in pneumonia, has been shown by experiment to be the most certain to produce tuberculosis in animals, and the author looks upon the presence of this matter in any organ of the human body "as the most important and the most frequent cause of tuberculosis in man." Of all the sources of cheesy matter caseous pneumonia is the most frequent, and this is the principal cause of tuberculosis.

"We have already explained that it is not a true miliary tuberculosis, but a caseous pneumonia, which is the most frequent starting-point of consumption. So long as the phthisis depends upon a caseous pneumonia alone it must be considered a local disease. . . . . As such phthisis may run its course to death or recovery without complication with tuberculosis. There may also arise—and this appears to be the general course—a secondary tuberculosis from absorption of the cheesy detritus. This is limited, at least in the beginning, principally to the neighbourhood of the cheesy masses, or of the cavities resulting from ulceration of the same. But, sooner or later, it extends to other parts of the lungs, or attacks the pleura, intestinal canal, larynx, etc. This is the course of chronic tuberculosis or chronic tuberculous phthisis."

Not only caseous inflammation of the lungs but of other organs gives rise to tuberculosis.

"I have not seldom had opportunity in my practice to see a laryngitis ulcerosa introduce the tubercular process while the lungs did not give the slightest physical indication of pathological change."

"We might say that a recognized starting-point of tuberculosis is formed by caseo-purulent exudations upon serous membranes, as the pleura and peritoneum. It has been proved by innumerable observations that tuberculosis, after such exudations, is one of the most frequent diseases. Heretofore, the explanation of this and similar occurrences has been by the convenient and ever-ready phrase: the tuberculosis occurs by reason of the general cachexia. But why does the tuberculosis occur here and not some other cachectic disease? According to our experiments, we can now give up this explanation—made to help us out of our difficulty—and replace it with one more precise, by saying that in these cases tuberculosis is a direct result of the absorption of the cheesy pus."

But in what relation to these caseous deposits, as cause of tuberculosis, stand the lymphatic glands which have undergone this peculiar caseous degeneration.

"In this manner is answered simply and satisfactorily our former question as to the relation of scrofula and tuberculosis. There is indeed an intimate connection between the two, an actual causative union; they stand to each other as cause and effect. *Scrofula can bring about tuberculosis by absorption of the cheesy lymphatic gland substance into the blood.*"

But there are other sources of origin of tuberculosis:—

"There is further an entire series of morbid conditions which have been looked upon for centuries as the causes of phthisis, and which have been thrown overboard only by the present time in it excessive scepticism and in accordance with the dangerous maxim: that which we cannot understand does not exist."

"The ancients taught that phthisis occurred after suppression of customary secretions and discharges, whether of physiological or pathological character, after the drying up, for example, of blennorrhagias and eruptions of the skin, after rapid healing of long-standing ulcers and fistulæ, after sudden cessation of menstrual and hæmorrhoidal hemorrhages, etc. We will consider all these points further on, and try to prove that the view of the ancients was not an arbitrary one, but rested upon experience and observation, and deserves to be considered by moderns. In all the conditions given we maintain, in harmony with our theory, that by the sudden suppression or healing of these affections, in part abnormal detritus matters are absorbed into the blood, in part pathological products which for years were accustomed to be thrown off, are retained in the blood, and thereby tuberculosis is occasioned."

Hæmoptysis, too, was with the ancients one of the most frequent causes of consumption, and so continued to be considered, until Laennec changed the doctrine and made it always a consequence and never a cause of tuberculosis.

"Also in reference to this point we find ourselves compelled to reinstate the doctrine of the ancients."

"The ancients were excellent observers, and their collected experience deserves far higher estimation than we in later times unfortunately think good to accord to them. Unsupplied with the objective aids of physical diagnosis, they were thrown entirely upon the subjective symptoms of disease, and were therefore, in general, far more acute in searching for them than we who, relying upon the instrumental modes of investigation, treat the others as of minor importance. . . . Frequently enough have I convinced myself in practice, and could adduce the individual instances in proof, that very robust persons, in perfect health, at least without an abnormal symptom, have been suddenly attacked by hæmoptysis, and upon this had followed all the signs of phthisis. Nor did Laennec ever succeed in entirely establishing his doctrine ; there were always, and even to our own times, influential opponents combating it."

That bronchitis may give rise to consumption the author firmly believes. The similarity of the early symptoms of the graver disease to simple catarrh, is good ground for the widespread and deeply-rooted general belief of this point in the minds of the people. His faith is founded upon a firmer basis, and the opposing explanation of Laennec, that the bronchitic symptoms depend upon tubercular disease, latent and not recognizable by physical examination, he terms an arbitrary assumption used as an after explanation.

He expresses himself in similar manner, but more strongly, as to laryngitis. Laennec held that the same relation existed between this disease and phthisis, as between bronchitis and phthisis, views which were opposed by Andral, yet which have held sway ever since.

"I began my observations as believing as possible, yet very soon many cases struck me, from the impossibility of harmonizing them with this dogma. For many years past, I have been convinced that this doctrine was not generally tenable. During many years I have devoted myself to diseases of the respiratory organs as a specialty, and have had abundant opportunity to see cases of commencing phthisis. Among these there have been many throat affections, in which the most minute physical examination failed to reveal even a trace of an abnormal condition of the thoracic organs. . . . In spite of the absence of lung symptoms these cases were very suspicious to me, and my prognosis was generally unfavourable. . . . Under my observation I saw not only the throat disease increase in extent and intensity, but symptoms on the part of the lungs gradually appear, dulness on percussion was perceived, and its increase followed, cough and dyspnœa followed, finally fever and death, with all the tormenting symptoms of lung and laryngeal phthisis."

To the objection that in these cases there was a latent tuberculosis, he responds: "Why should we prefer, out of respect for an hypothesis already undermined, to interpret afterwards by assumption of a latent condition of an objective something not susceptible of proof, instead of accepting as present what exact observation shows?"

That tuberculosis frequently follows suppurative inflammation of serous membranes, especially of the pleura, is claimed to be a fact accepted by all and denied by none. In the explanation the author of course differs from those who attribute it to the constitutional cachexia; with him it is a consequence of the absorption of the shrivelled pus cells and the detritus of caseous deposit. Purulent collections anywhere, especially if long pent up, thus become fruitful sources of tubercle ; joint diseases, caries, and other instances are given with illustrative cases. Tröltsch is again quoted, and his testimony given as to the frequency with which tubercular meningitis follows purulent otorrhœa.

The origin of phthisis and tuberculosis from the healing of old ulcers and fistulæ, and the suppression of discharges, is "not only denied by the moderns, but laughed at as a fable." Yet some of the best names in the profession can be brought in support of the doctrine. Morton, Sauvages, Cullen, Portal, and Schönlein, are among the number.

> "With what right do *we* presume so lightly and so inconsiderately to throw aside the observations of our predecessors and the experience of centuries? Do we attribute so slight powers of observation and so little strength of judgment to such men as Hoffman, de Haen, Portal, Autenrieth, Schönlein, and a hundred others, that they were not able to avoid the 'post hoc ergo propter hoc?' Is this piece of wisdom only an acquisition of modern times?"

In this strain he maintains the credit as careful observers and reasoners, of men who showed themselves to be skilful practitioners and good logicians even without the pleximeter, stethoscope, and all the appliances of modern physical diagnosis, and holds that an empirical science like medicine cannot afford to ignore their labours. Farther to sustain his views as to this cause of tuberculosis he refers to many authors, and gives cases of his own, especially in regard to the influence of healing anal fistula.

One or two other points remain to be touched upon: The influence of constant inhalation of foreign particles, as in the well-known "dry-grinder's rot," and the consumption of mill-stone cutters, is, of course, adduced as supporting the author's theory. He refers to his work upon Inhalation for full information upon this subject.

The direct hereditary transmission of tuberculosis he denies.

> "I have carefully examined almost all the young of animals experimented with, whether born early or late, and I never found in any organ a trace of tubercle or anything similar."

Virchow has said the same. He believes then tubercle is always acquired, never congenital. The inheritance is indirect; it depends upon the transmission of a disposition to those forms of disease, caseous pneumonia and scrofula, to which tubercle is secondary.

The doctrine of the contagiousness of phthisis is favoured by the author. That it is highly so he admits is not possible, but the occurrence of the disease in those who have long and closely waited on phthisical patients is too frequent and too marked to be slighted. The medium of contagion he believes to be the minute particles expelled by coughing and respiration from the lungs of the diseased which, being inhaled by the healthy, produce first irritative catarrh, and lead afterwards to tubercular disease.

The prophylaxis and therapeutics of the disease are beyond the limits of the work, as indicated by the title-page. Nevertheless, in conclusion, the author gives a brief indication of the principles which should govern us in preventing and treating the different forms of these affections. He considers prophylaxis under two heads: that of the primary diseases—scrofula, phthisis, caseo-purulent inflammations, etc.; that of tuberculosis when the primary affections already exist. In the hygienic treatment of scrofula he has nothing new to offer beyond the rules laid down by good authorities already relating to food, clothing, exercise, good air, prevention of inflammatory attacks, etc., and extending from the earliest infancy to adult age. Upon one point we quote:—

> "Great care is demanded in the vaccination of children disposed to scrofula. It should be undertaken only when the children are entirely well, and only lymph should be used which is perfectly clear and free from detritus and pus and blood corpuscles."

In a former part of the work he has considered the argument against vaccination advanced by its opponents, that it transmits scrofula. He rejects it entirely, and assents to the correctness of the general belief that the scrofulous manifestations are only excited, and not caused by the vaccination; yet he thinks there is some ground to support the argument when the dried crust is used instead of pure lymph, and therefore warns against this practice.

We may repeat what we have said of the hygiene of scrofula for consumption, and make but few additions.

> "Where circumstances allow, the growing children or youths should live, or spend some portion of every year among the mountains; the purity of the mountain air is curative, while the lessened barometric pressure, as well as the exercise of ascending heights, expands the chest and makes the lungs richer in blood."
>
> "Bronchial catarrh in persons of consumptive habit should be treated as a serious disease; even when it is insignificant the patient should be confined to his room. If pneumonia or pleurisy occur, phthisis should be kept in view as a threatening eventuality, and should influence prognosis and treatment."

If any of the primary diseases which lead to tuberculosis already exist, our endeavours must be directed to prevention of this grave complication. The author admits that in the present state of our knowledge it is impossible to say why some persons can carry about for years cheesy deposits without tubercular complication while others rapidly succumb to the graver malady from an insignificant amount of the same.

In the treatment of diseased lymphatic glands he advocates decided measures.

> "Easy as it may be, as a rule, to cause the disappearance of simply tumefied glands, even so vain is every attempt to cure those which have already undergone the caseous degeneration. Here the rule, which many surgeons have long since adopted, should be general, to extirpate such cheesy glands *in toto* as soon as they are accessible to the knife without danger. They should be removed entire from among the healthy tissues, and great care should be taken not to cut or crush them, or even to continue the operation with the knife which, perhaps for the purpose of examination, has divided them; not a particle of the cheesy matter should remain in the wound!"

In view of the frequency with which phthisis follows suppurative pleuritis every attempt should be made to prevent the thickening of the exudation.

> "The only means of affecting this is paracentesis, which should be resorted to much more frequently than it is, and especially when we are convinced that the exudation is purulent, or when it remains longer than usual without undergoing absorption."
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> "Laryngeal affections, especially the ulcerations, should be submitted to a careful local as well as general treatment, and we should not content ourselves with the false and dangerous alternative: either it is phthisis, and then all treatment is useless, or it is a local ailment which treatment by internal means will cure, or if not cured at all is of little account."
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> "Fistula in ano in patients of phthisical or scrofulous tendencies should never be operated on; in strong robust persons it should only be resorted to when the inconveniences of it are very considerable, when it has not been of long standing, and after laying plainly before the patient the possible danger of the procedure."

We pass on to the treatment of phthisis and tuberculosis :—

> "We must first of all once more emphasize the fact that the curability of phthisis is established beyond all doubt. Until the beginning of the present century scarcely any one denied it. Laennec already—not to mention Portal—reported a series of exact observations which proved the cure of phthisis. Cicatrices in

the lungs are so common that Cruveilhier, as we have seen, declared the healing of lung cavities to be one of the commonest occurrences. Only the excessive scepticism of our century has been able to deny this curability. . . . Happily the most recent period has begun to emancipate itself from this scepticism, which indeed also has rendered extraordinary service in the advancement of our science, and whose services and justification are therefore undeniable. Whoever observes without prejudice must be convinced that recovery from phthisis is far from seldom. And if we consider the several attacks of caseous pneumonia in the course of phthisis as completed diseases the recovery appears much more frequent. We are altogether too much accustomed to look upon consumption as a continuous disease; the idea that a person may suffer more than once of phthisis is foreign to us. Generally, however, it is not a single caseous pneumonia, but a succession of pneumonias at different periods of time to which the patient succumbs, while in the intervals he is entirely or relatively well.

"Viewed in this light, consumption is one of the most curable of the dangerous chronic affections, and its treatment is often to the physician a gratifying task. Compare it for instance with the chronic brain diseases, nephritis, carcinoma, etc.; how hopeless are these in comparison with it? Truly enough, if we are to obtain a satisfactory result, the circumstances of the patient must be such as to allow not only the following out of the most comprehensive medical treatment and dietetic regulations, but also the making of considerable sacrifices, such as travelling, change of residence, etc."

The therapeutics vary according to whether the case is one of cheesy pneumonia or miliary tuberculosis. If the former, in acute or subacute stages, a mild antiphlogistic course is indicated; local depletion, febrifuges, moderate diet. If these stages are prolonged, a better diet and strengthening measures are to be ordered in spite of the fever; after their termination more decided measures, such as the milk cure and cod-liver oil. The local treatment consists of measures to favour the elimination and expectoration of the cheesy deposits. "It is the remaining caseous matter and the cavities partially filled with detritus, which, so long as they exist, not only maintain the disease, but continue the danger of tuberculosis." Inhalations are beneficial, and more so in proportion as the trachea and larynx are affected; steam or vapour is preferred to atomized fluids, and he uses most frequently solutions of alum or tannin, or sometimes tar water.

"The most important measure in the treatment of phthisis, indeed the sovereign remedy as compared with all others, is climate. If it is taken advantage of early enough, and not, as unhappily is too often the case, when it is already too late, we may expect the best results from it. I have observed, and every physician as well as myself must have observed, the most cures of chronic phthisis from climatic influences; it is true many are but temporarily benefited, but sometimes there are perfect cures. Either the patient may remove entirely to a southern clime—the choice of place depending upon the individuality of the case—or he may spend several winters at the south. In summer let him pass his time among the mountains; the light atmosphere acts as a gymnastic for the lungs, and promotes the flow of blood through them."

The therapeutics of tuberculosis is far different—so short and sorrowful a story as scarcely to allow of mention.

"It is more than questionable whether we are able to limit a commencing tuberculosis by any means at our command. If we assume what is probable, that the tuberculosis, especially when occurring in a more or less free interval of a phthisis, manifests itself by a remitting or intermitting fever, we may maintain that in many cases we can control this fever. Frequently we can treat it successfully with quinia; in other cases where quinia has failed, I have seen unexpected good result from the administration of Fowler's solution. But whether with the moderation and cessation of the fever, the tuberculosis is checked remains open to very just doubt. No less unreliable are other medicines of reputation in 'lung tuberculosis.' We may continue to try the customary measures, whey and milk cures, and mineral waters, as well as cod-liver oil, only observe whether they are of any use against true tuberculosis! It is not very different with climatic influences, although we may be allowed to expect more from these."

Nevertheless his observations upon animals show that there is sometimes a tendency to recovery even from miliary tuberculosis, and Empis formally adopts this view.

One measure of local treatment he looks favourably upon, although he does not recommend it in strong terms; it is the use of setons and issues. They were in high favour with the ancients, and he thinks he has seen good results from them. We mention this point because it does not seem to us to accord with the author's doctrines in view of the results obtained by experiment on animals of Wilson Fox and others. If tubercle follows any prolonged suppuration in animals, why not in man? If an otorrhœa or a carious bone is likely to produce it, why not a suppurating issue? It would seem as if the dry cupping and vesicants "with which, as palliatives, we have no reason to be discontented," are better.

The object we have had in view in preparing this notice of Dr. Waldenburg's work was simply to present his views with some indication of the arguments upon which he bases them. The task has not been an easy one, from the wide range of the subject and the mass of matter to be condensed within the limits of space at our disposal. Nevertheless the attempt has been faithfully made, and if in doing so we have trespassed upon the patience of our readers, the vast importance of the subject must be our excuse. If they gain from its perusal no new principles of treatment, even if no new facts are learned, it will not be without benefit to observe the attempt at progress which earnest workers are making, and to gain an idea of the "violent fermentation" the doctrines of tubercle and consumption are at present undergoing. J. C. R.

ART. XXI.—*The Science and Art of Surgery. Being a Treatise on Surgical Injuries, Diseases, and Operations.* By JOHN ERIC ERICHSEN, Senior Surgeon to University College Hospital, and Holme Prof. of Clin. Surg. in Univ. Coll., London. From the fifth enlarged and carefully revised London edition. Illustrated with 630 engravings on wood. With additions. By John Ashhurst, Jr., A. M., M. D., Vice-Pres. of the Philadelphia Path. Soc., F. C. P. Phila. Surgeon to Episcopal Hospital, etc. etc. Royal 8vo. pp. 1228. Philadelphia: Henry C. Lea, 1869.

THE republication in this country of the fifth London edition (1868) of Mr. Erichsen's *Science and Art of Surgery*, with the valuable additions of Dr. Ashhurst, the American editor, cannot fail to be kindly received by the profession throughout our country. Occupying, as it does in Great Britain, the high position awarded in this country to the admirable *System of Surgery*, by Professor Gross, it has a peculiar claim upon our notice, as it embodies throughout not only the views of the Senior Surgeon to the University College Hospital, but those of his countrymen who have shed such lustre upon this department of the healing art. The perusal of the